# Teaming up for the solar powered future

Thinking BIG, being **bold**, working together

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Australian National University

Fenner School of Environment & Society

The Australian National University

Also noting:
CTO and Co-founder, Solcast

13th April 2017

# Introductions

Let’s connect!

@nickengerer

LinkedIn -> Nick Engerer

nickengerer.org

# Professional Objectives

Smooth the transition of the electricity sector to high penetrations of solar energy technologies

Raise the allowable penetration levels of solar PV in our electricity markets & networks

Challenge the barriers between university research/ education and the ‘real-world’

Australian National University

SOLCAST

# “Human” Objectives

To inspire & network with my fellow humans to accomplish BIG, **bold** ideas

Change our narrative: *Creating the Abundant Future*

*“I have a very simple metric I use: Are you working on something that can change the world? Yes or no? The answer for 99.99999% of People is no. I think we need to be training people on how to change the world.”*

-Larry Page, CEO, Alphabet-

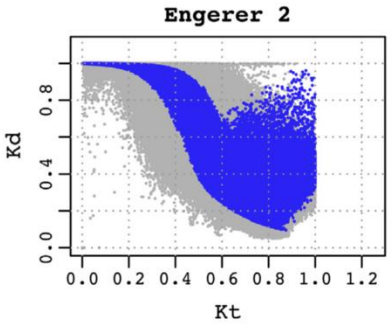
# Doing BIG, **bold** things

The Ph.D., BIG ideas & the reality of their realisation

# The PhD – The Regional PV Simulation System

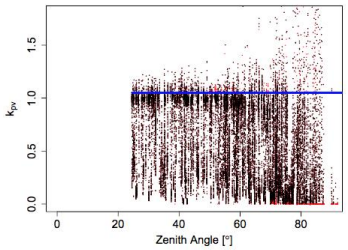
$K_{PV}$ – PV Power Upscaling [bit.ly/what_is_KPV]

$$K_{PV} = \frac{PV_{MEAS}}{PV_{CLR}}$$

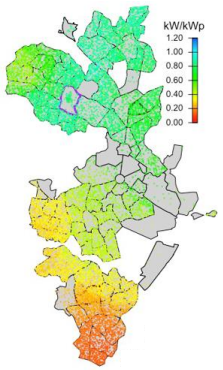



Building & Validating Radiation Models

Engerer2 model [bit.ly/engerer2]




Quality-controlling Distributed PV Power Data [QCPV]



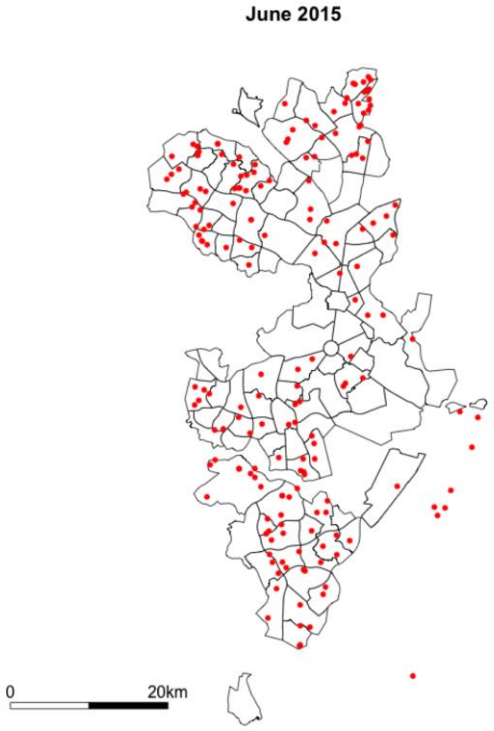

Prototype Distributed PV Modeling System: RPSS

Read more: bit.ly/nengerer_phd

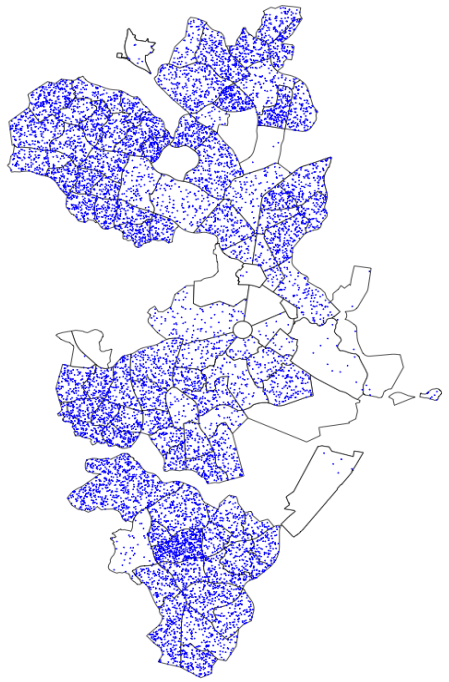
"Science off the shelf"

# How the pilot version worked

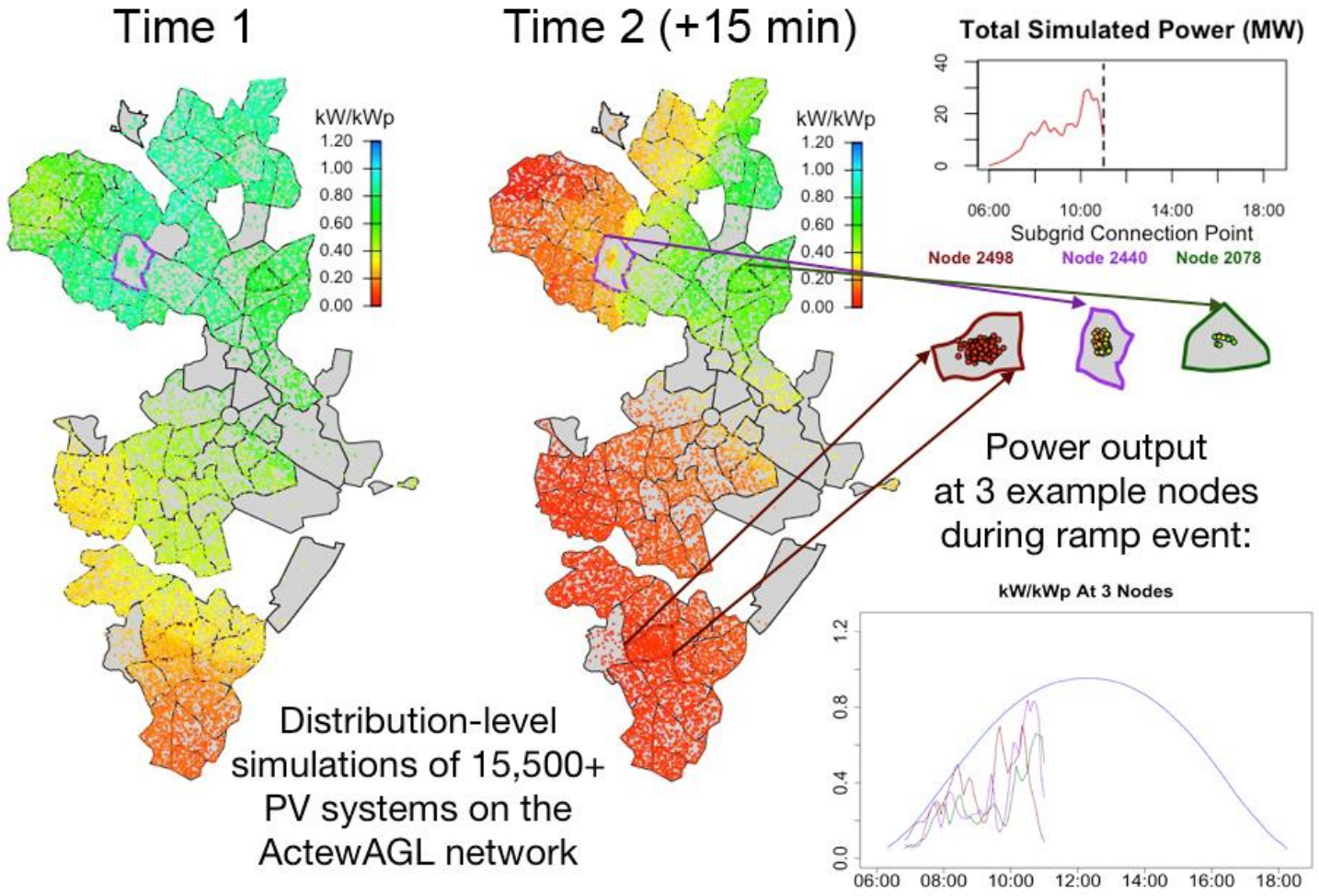
Live data from 100+
PV systems via PVOutput.org




Embedded PV generator installation information from ActewAGL

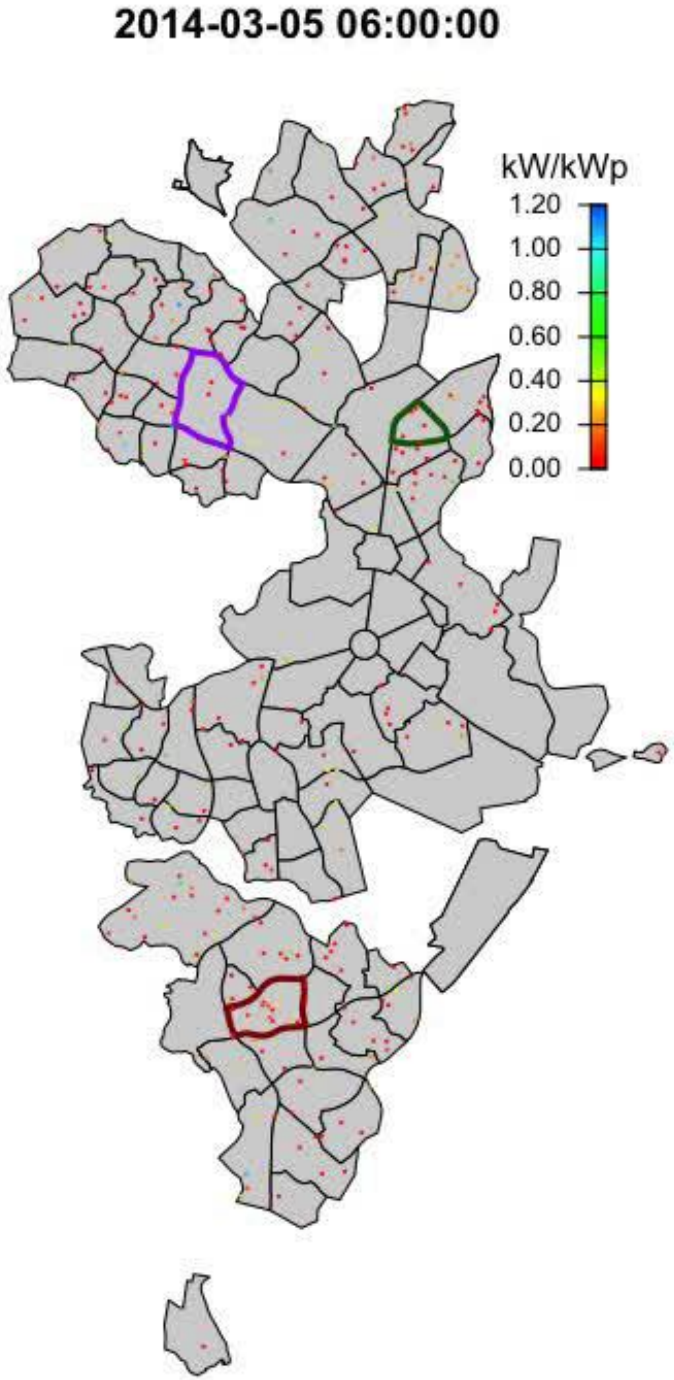


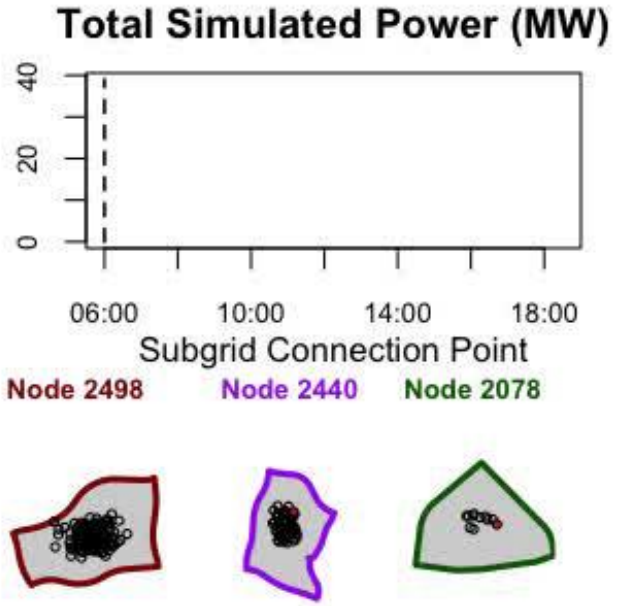
# RPSS: Regional PV Simulation System



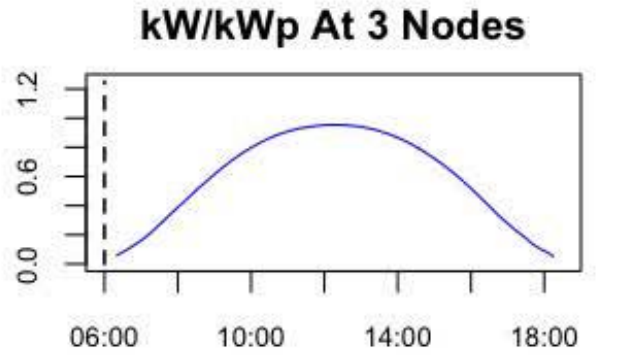
# RPSS Highlight: modelling ramp events

Watch this event:
bit.ly/ARENA_DNSPs



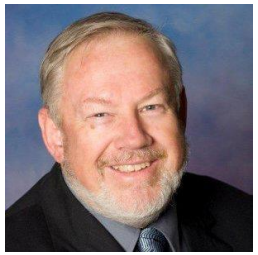





# Encouragement from Mentors

## Post Ph.D. Exit Seminar:

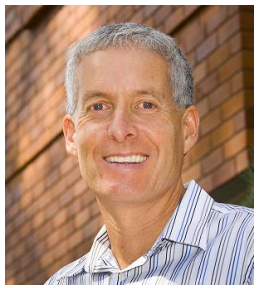


"Industry needs this, you should keep working on it"

Steve Blume, Australian Solar Council

"There is an ARENA Industry R&D roudn opening up, you should apply for funding with this tool"

Prof. Andrew Blakers, ANU



# Acting on their advice

I started off thinking *comfortably*

a small project, one industry partner, an ANU Professor to be the C.I…

But my life's experience said: "Go BIG, Be **bold**!"

Life can be short, we have no guarantees, what was I *afraid* of?

# BIG ideas are challenging


## Industry Challenges:

Identifying contacts, following up, meeting deadlines, rejection!

## University Challenges:

Omission, inexperience, industry cash, IP, internal procedure + delegation

## Collaboration Challenges:

Institutional barriers with IP, sharing of funding, negotiating timelines

Awesome Rooftop Scale Solar
PV Modelling R&D Work

# Pulling it off:

"Real-time operational PV simulations for distribution network service providers"

3 year project, led by the ANU

Recipient of ARENA funding ($1.02M)

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Partnerships: 6 DNSPs, 2 inverter companies, SolarHub, APVI, Solcast

Tasked w/ the delivery of distributed PV modelling operationally to DNSPs

Read more:
bit.ly/ARENA_nengerer circa November 2015

# Project Overview

## $3.6M Project, ARENA & Industry backed ($1.6M cash) [2016-2019]

"Real-time operational PV simulations for distribution network service providers"

Outcomes: 1) Deploy distributed PV forecasting for DNSPs

2) Commercialise the technology via **Solcast**

Outputs: 1) Distributed PV forecasting system that utilises the Himawari 8 satellite and real-time PV monitoring data

2) Groups forecasts by distribution network assets, provides outputs to DNSPs in manner usable by their operational systems

Objective: Demonstrably raise the allowable penetration levels of distributed solar in participating networks

*“Our evolution as a species has depended on the creation of a tremendous diversity of skills and ways of thinking. We thrive by the collective activity of people supplying their individual talents. Without such diversity, a culture dies”*

- Robert Greene -

# My Core Message for Today

Collaborating to make BIG ideas happen

# Off to Perth!


April 2016


ARENA

Australian Government
Australian Renewable Energy Agency

9 projects were funded, $17M total

All Uni-industry driven projects

Commercialisation potential

# Off to Perth: A Realisation


Wandering the streets of Perth that evening

LNG18

The Big, Tall Buildings!


bhpbilliton
RioTinto
Deloitte.
EY
The New Esplanade Hotel

# A Realisation

The future of electricity will be comprised of a spectrum of highly distributed energy resources

And just as the generation is distributed, so are “we”

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**We must become those big, buildings together**

# A Realisation

The future of electricity will be comprised of a spectrum of highly distributed energy resources

And just as the generation is distributed, so are “we”

We must become those big, tall buildings together

This means removing barriers, thinking BIG & **bold**

# Strong When Together, Weak When Apart

We are already bound together by our values, by our vision

But we are separated by our own fear, misunderstanding and priorities

We all have the same objective: the rapid integration of renewables

& in particular, a solar-powered future

# Three Key Points; For Action

1) It all must start with a belief in **Abundance.**

We alone, shape our future!

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3) Adopt the philosophy of enablement

Apply your skills & effort in a way that enables others; build things collectively

*“I found if I kept anything as my own, I had to defend it against the world”*
- Mahatma Gandhi -

# A Philosophy of Enablement

DNSPs, Fellow Researchers, Industry Participants, Each Other

Working together to make BIG things happen

# The ARENA Project Today: Enabling DNSPs

Expand RPSS into all partnering DNSP networks

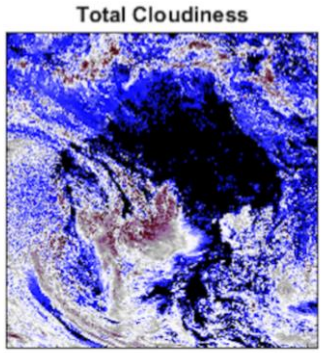
DNSP provides detailed embedded PV generator installation data

DNSP organises the above data by distribution assets

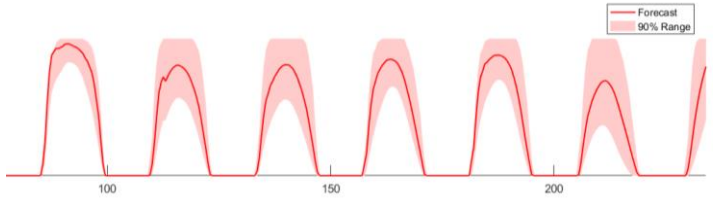
Delivery via an API for DNSPs

SOLCAST

## Solar Forecasting Engine




Himawari 8
0-6 hours
1km$^2$ at 10min

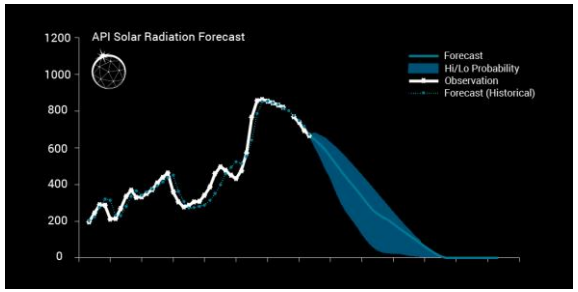


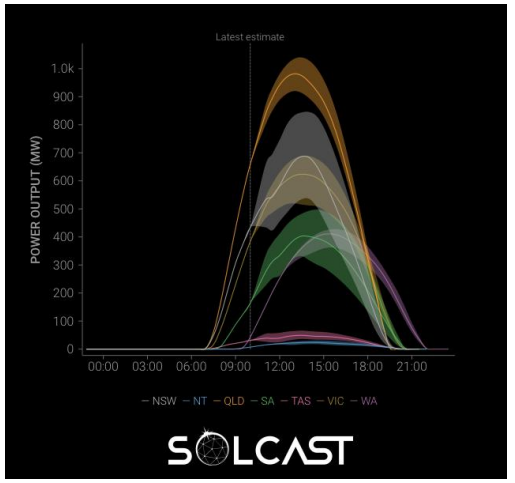

Numerical Weather Model Ensemble
6-168 hours
30 minute

1) Alpha-testing
May-Dec 2016
2) Go-Live
Dec 2016

## Solar API Launched Feb 2017

1. Solar radiation (GHI, DNI, DHI) & PV power forecasts globally, high-res over Australia
2. Solar radiation & PV Power estimated actuals over Australia
3. State-level small-scale solar forecasts & actuals Australia-wide
4. Connection point API* (~June 2017)




API Call

Australian National University

## DNSP PV Data

POSTGRES Database
w/ statistical models for PV orientation

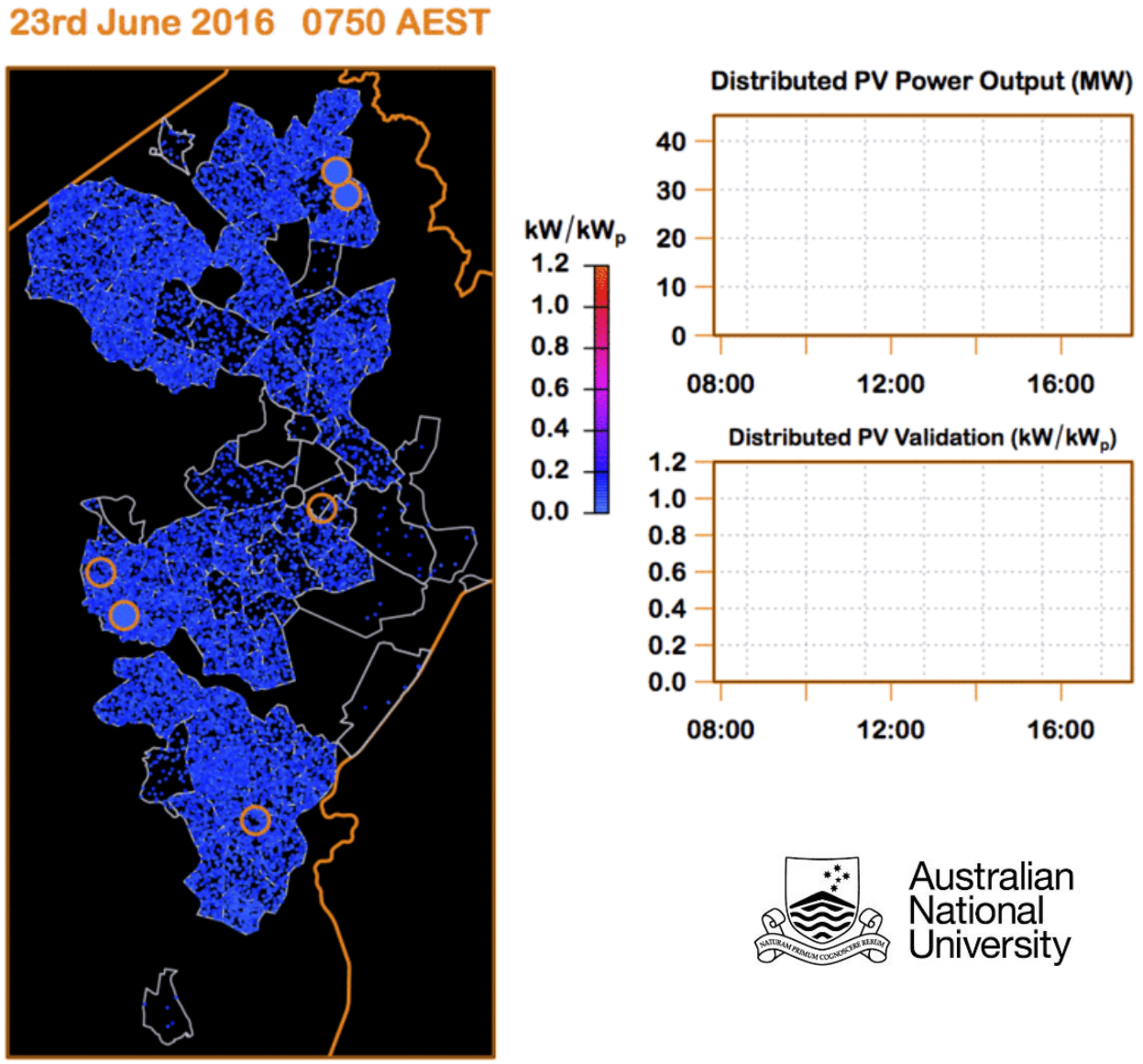
## DNSP Network Data

POSTGRES Database
Aggregate PV forecasts by network asset

*Connection Point Solar Forecasts

# Himawari 8 Enabled RPSS

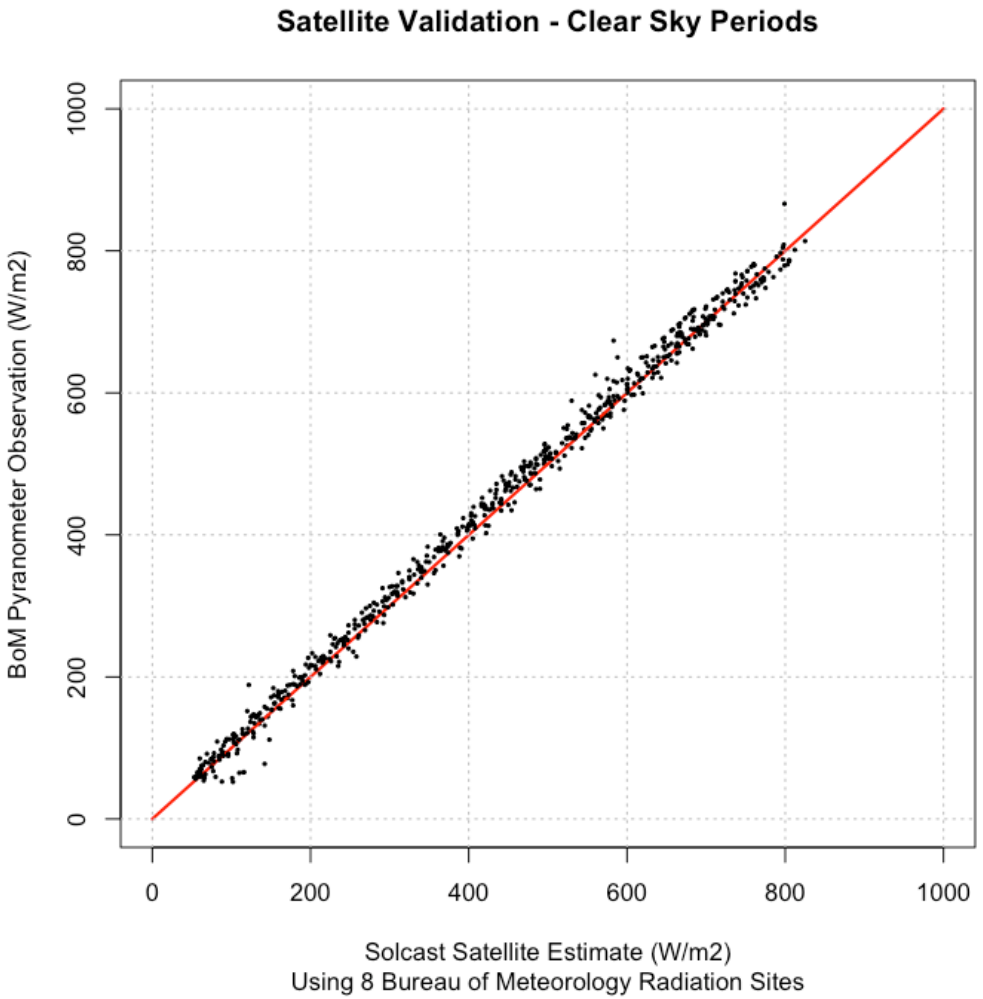
- H8 radiation nowcast
- State of the art radiation modelling (Engerer2)
- Validation against 6 test PV sites (at bottom right)
  - red PV actuals
  - grey satellite based estimate



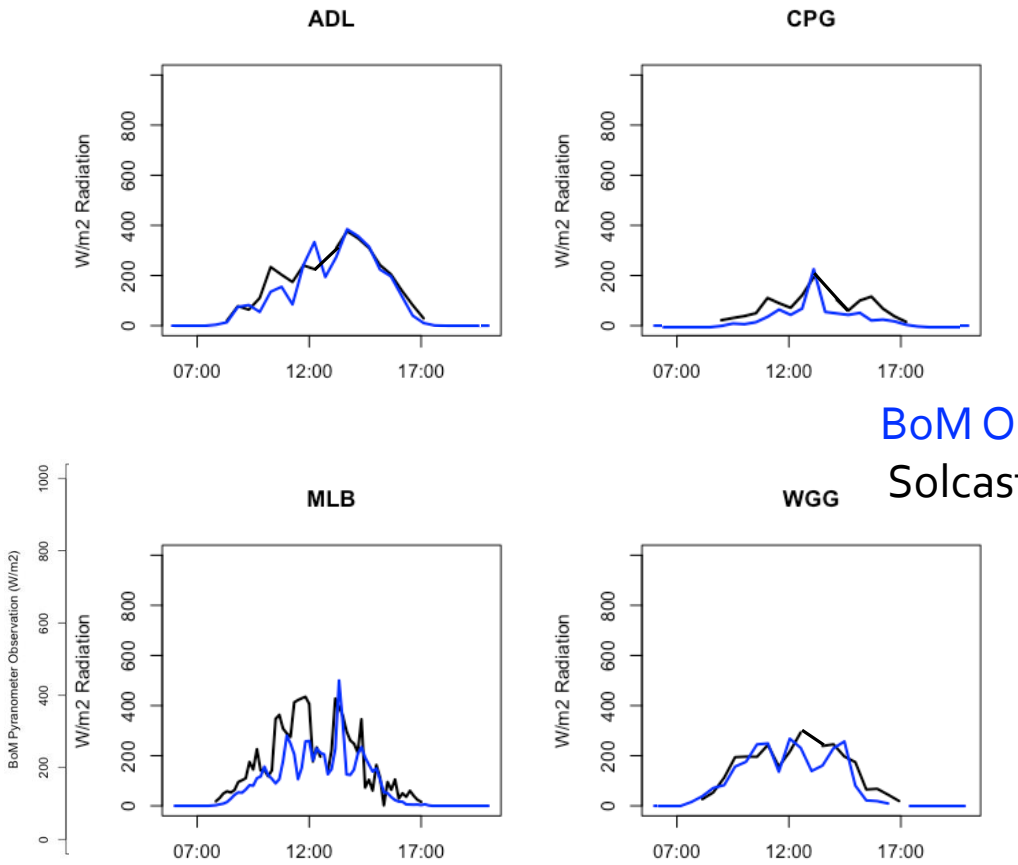

Australian National University

# Satellite Radiation Validation

Cloud-free periods accurate to within 1.5%




All sky periods accurate to within 8%
30-minute intervals



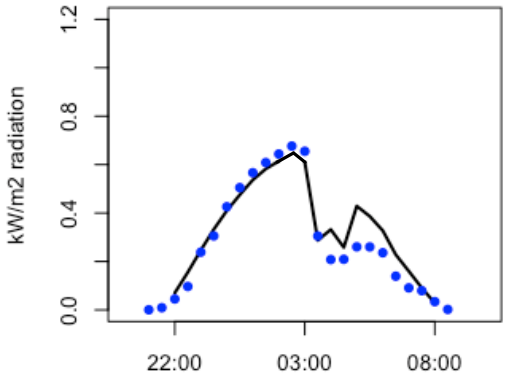

BoM Observation
Solcast Estimate

30 June 2016
Timeseries

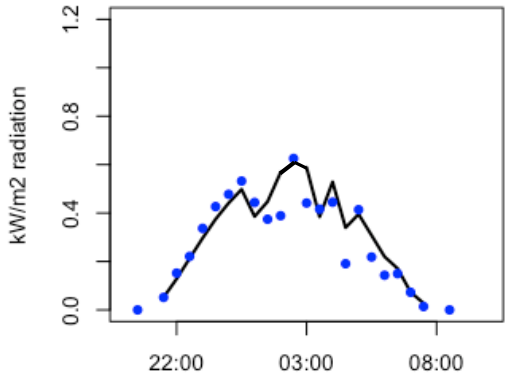
## BoM Observation v. Solcast Estimate

20 August 2016
Timeseries

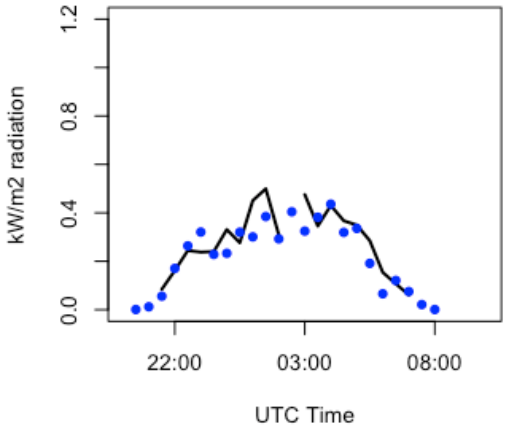
Adelaide



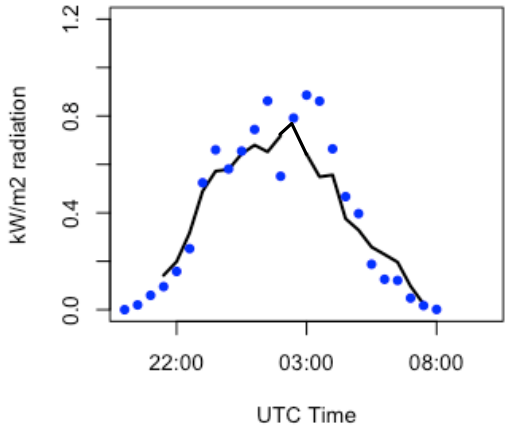

Melbourne



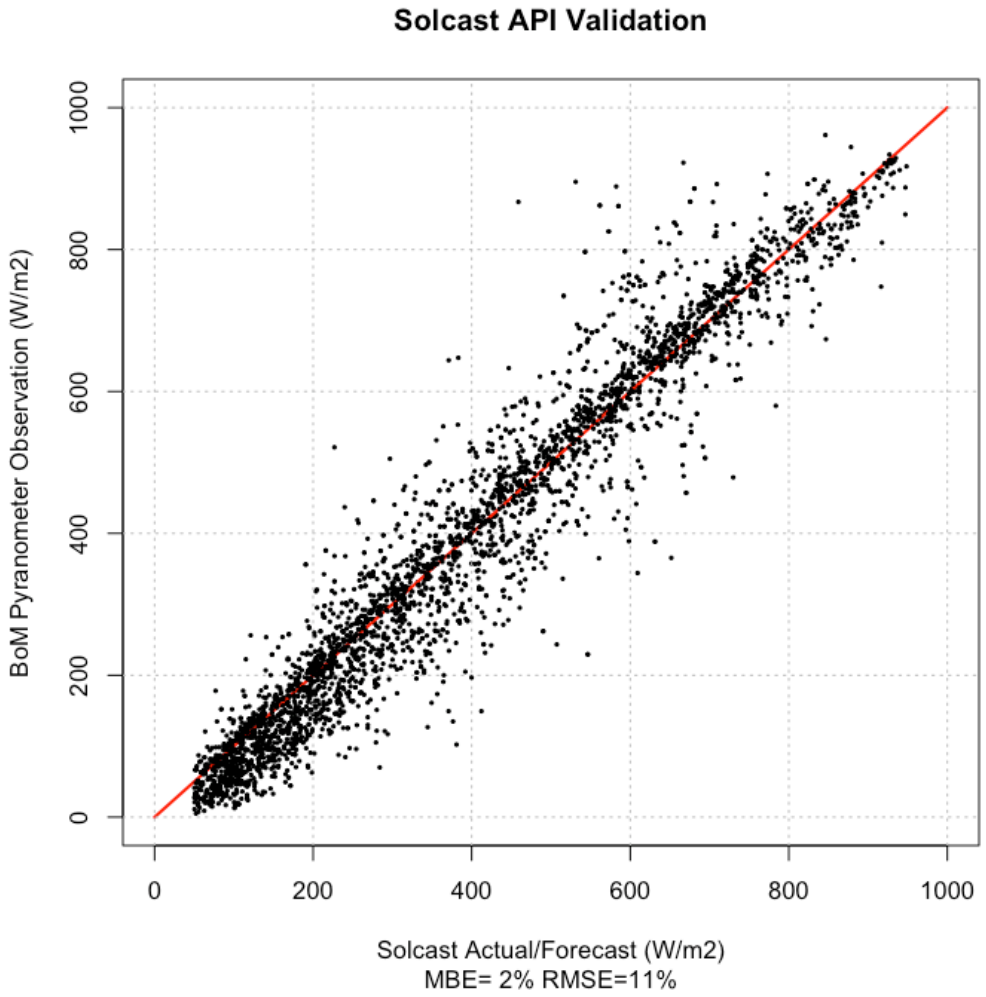

Wagga Wagga



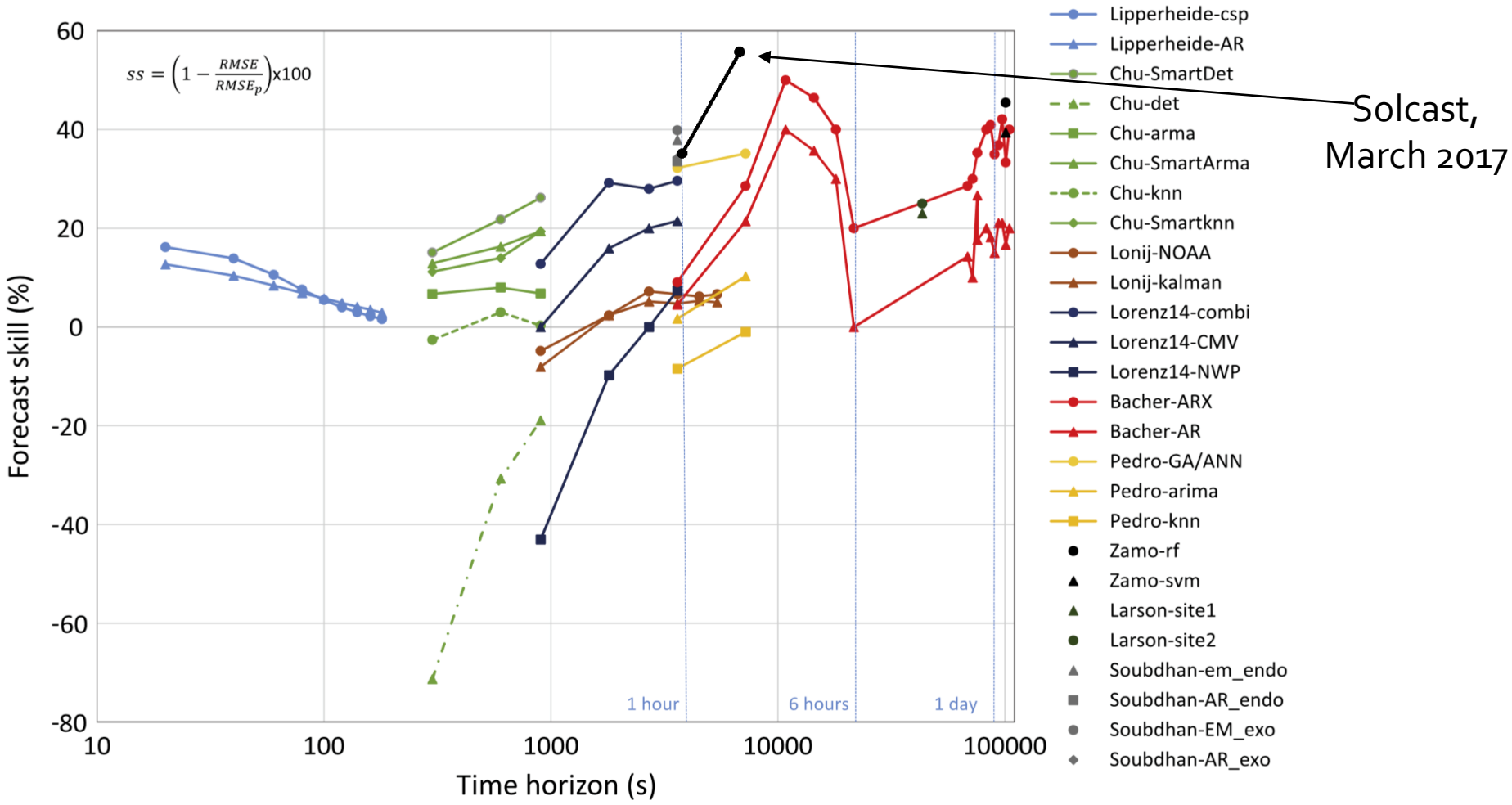

Rockhampton




## Across 8 BoM Sites July-August 2016



# #SolcastAPI: Performance & Validation




Solcast, March 2017

**Fig. 9.** Comparison of forecasting skill *ss* of different approaches.

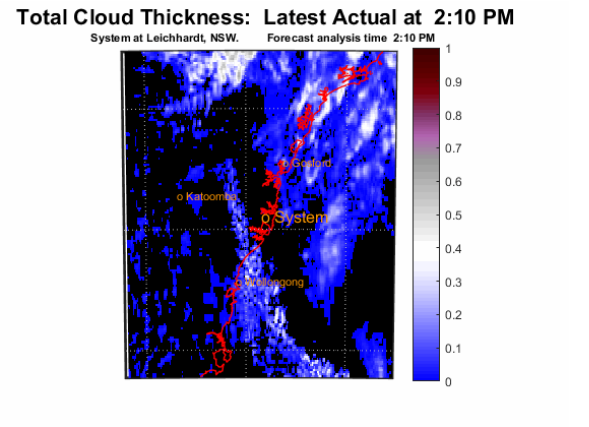
# Development pipeline: Inverter Data

We are partnered with SMA Australia and Fronius

Delivery of real-time updates from all monitored PV systems in Australia

We'll use this data to cross-validate RPSS nowcasts

# ARENA Project Today: Enabling R&D via our API

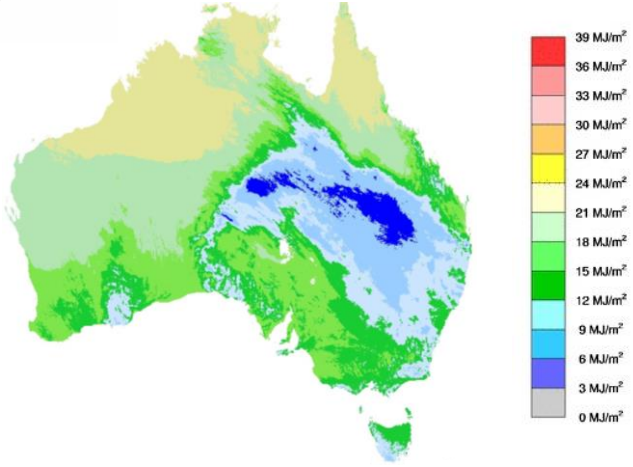



Real-time 0-7 day radiation & PV power forecasts anywhere in Australia

GHI, DNI, DHI

Australia-wide high-resolution irradiance data

GHI, DNI, DHI




The **#SolcastAPI** open & available now for researchers

DNSP level data incoming via ARENA project

Maintain open access for R&D

Planned delivery of datasets to APVI & AREMI

# Working Together

## Putting aside our fears misconceptions

We are on the same team!

## We want to know, what you want to know

How can our team enable yours?

## Let’s build meaningful collaboration

Prioritising, Thinking BIG & “Creating the Abundant Future”

# Working Together: UNSW Specifics

Distributed solar forecasting

Solar power output datasets, quality control & modelling

Solar PV grid integration modelling & challenges

+ YOUR ideas

# Closing

Let’s connect!

@nickengerer

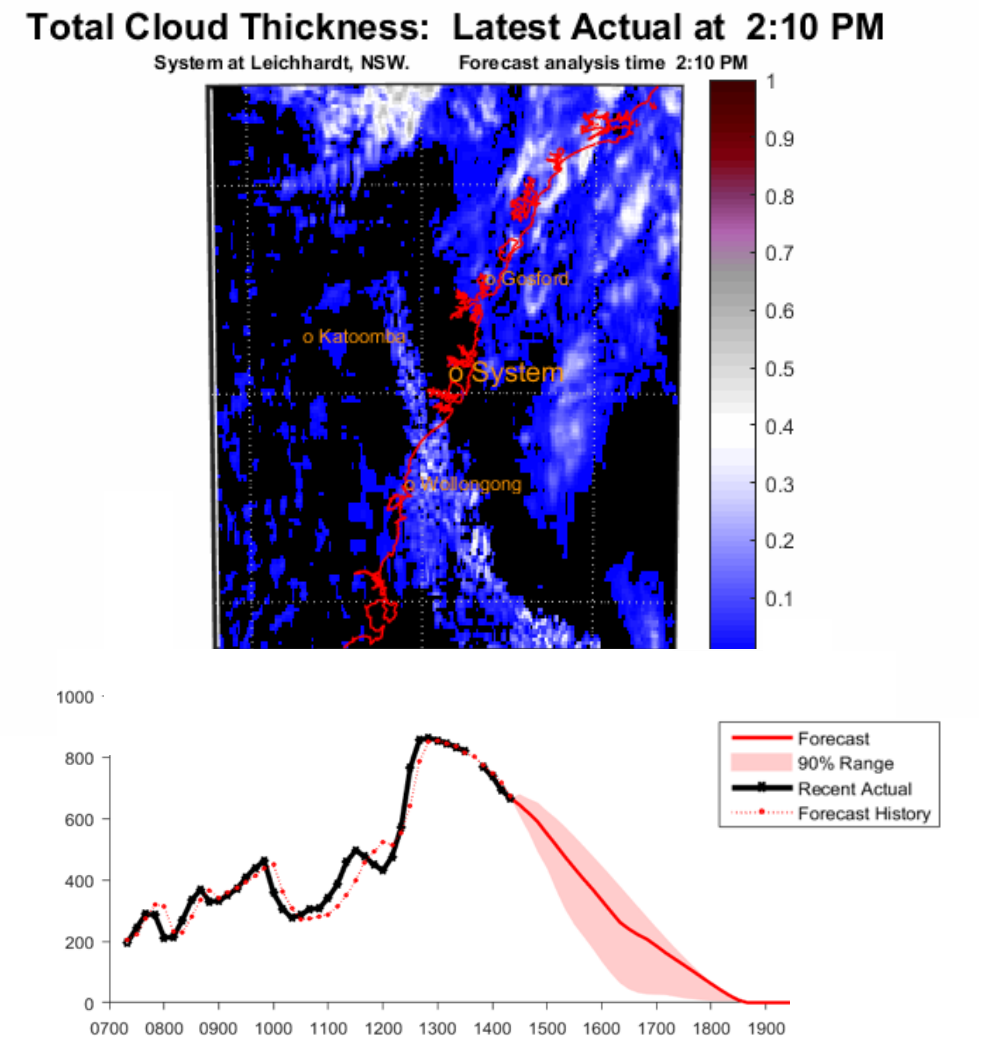
LinkedIn -> Nick Engerer

nickengerer.org

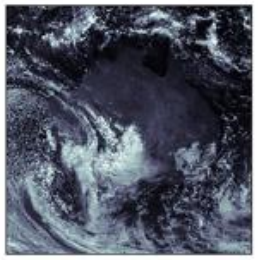
# Technical Deck

For Reference, Q&A

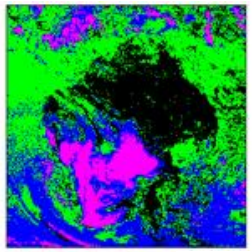
# Semi-Dynamical Nowcasting



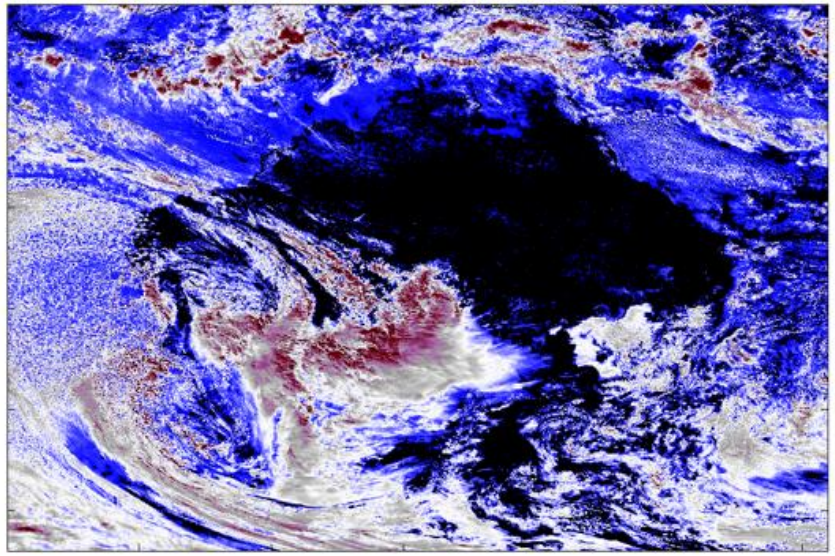

Visible



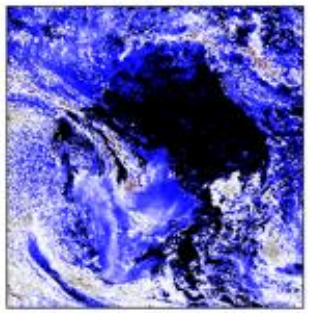
Cloud Top Height



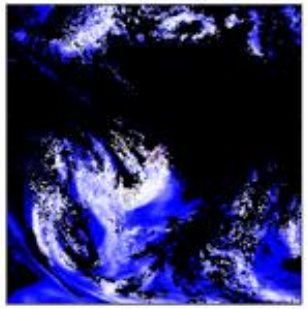
Total Cloudiness



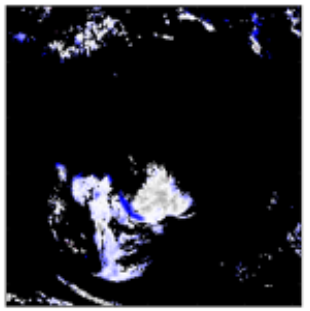
Low Cloudiness



Mid Cloudiness



High Cloudiness



# Solcast Forecast Validation